TRANSMISSION ANALYSIS REPORT
ON
12KV LINE 5731 FAULT
AT
TSS 57 FOREST PARK

Summary: On August 3, 1999, at approximately 9:10AM, at TSS 57 Forest Park, 12kV Cϕ cable on Line 5731 Bus 1 faulted. The fault cleared via back-up protection on 69kV L.19201 and the 12kV Bus 2 Bus-Tie. An investigation revealed there was no DC control voltage feeding the protective relays for the Transformer 1 12kV Circuit Breaker, 12kV Bus 1, or its associated feeders. After corrective action was taken to restore DC to the protective scheme, Transformer 1, 12kV Bus 1 and its feeders were tested and restored to service at 9:00 AM on Aug. 4, 1999.

Relay	TSS57 Forest Park :	TR2 – CO-EI
Targets		L19201- RDTT
Recorded:	TSS192 Ridgeland :	L19201- 21-Z2, KD-3
		21X, TD-5
		86LOR
	TSS59 Cicero:	L19201- RDTT/192
	TDC556 Berwyn:	L19201- RDTT/192
	DCD522-1:	L19201- RDTT/192

Discussion: 125V DC Circuit #5 at the DC panel board supplies the control voltage to Transformer 1 and 12kV Bus 1 via Cable #0120. Cable #0120 runs from the indoor 125V DC panel board to outdoor Bus 1 Cubicle 1. During the original installation of Cable #0120, a tap was made to the cable within the trench to provide DC to the protective relays for Transformer 1 and 12kV Bus 1. The tap in the trench was not noted on the cable table print (57E-3000C) or on the wiring prints which show the destination and origin of Cable #0120. The only notation regarding the cable tap on Cable #0120 was found on the wiring diagram (57E-4004E) for Cubicle 6 in the control building. Cubicle 6 was the destination of the cable tap. The cable tap from Cable #0120 was used as the source of DC voltage to the protective scheme of the Transformer 1 12kV Circuit Breaker, 12kV Bus 1, and the associated feeders off the bus.

On Saturday May 1, 1999, following routine maintenance on Transformer 1, the 12kv transformer breaker for Transformer 1 would not close electrically. In addition, the circuit breaker status lights for Bus 1 flickered repeatedly and appeared dimmer than the control lights for Bus 2. The problem was traced to an 85V DC ground on the positive conductor of Cable #0120. The section of Cable #0120 between the 125V DC panel board and Cubicle 1 was replaced and the breaker was tested. It closed electrically several times and the control lights were brightly lit with no flickering. The old failed Cable #0120, along with the cable tap to Cubicle 6, were abandoned in place.

On August 3, 12kv L.5731 faulted and failed to clear via feeder protection. Backup relaying also failed to clear the 12kv Bus 1 Bus-Tie and the Transformer 1 Circuit Breaker since there was no DC source feeding the protective relays. Instead, Transformer 2 Time Program Trip - Step 1 operated and automatically opened the 12kV Bus 2 Bus-Tie. In addition, 69kV L.19201 opened remotely at TSS 192 Ridgeland sending Direct Transfer Trip signals to all locations.

Contributing Factors:

There was a lack of information regarding the presence of a cable tap off of Cable #0120 and control building switchboard Cubicle 6 of Bus 1.

- The cable table print for DC Cable #0120 indicates that the cable is connected between 12kV Bus 1 Cubicle 1 and the main 125V DC panel board. There was no indication that the 12kv Bus 1 protective relaying was also fed from Cable #0120 via a cable tap.
- The wiring diagrams for both the 125 VDC panel board and 12kV Bus 1 Cubicle 1 includes information regarding the origin and destination of Cable #0120. Neither wiring diagram identified the presence of a cable tap.
- The only note of the cable tap was on the wiring diagram for Control Panel 6 in the building, which indicated the presence of the tap between Cable #0120 and Cubicle 6. It was described as a "TAP TO (+) IN Cable #0120 IN TRENCH".
- Tripping schematics displayed 4 different trip buses off the same DC Circuit #5. Each bus serves the devices off Transformer 1, Bus 1, and its feeders.

Conclusion:

To eliminate future confusion, the tap off of Cable #0120 was removed from switchboard Cubicle 6 in the building. A new cable, Cable 1179, was terminated at DC panel board Auxiliary Cabinet to feed switchboard Cubicle 6 in the building and serve Transformer 1, Bus 1, and the associated feeder relays. Voltages were measured at the appropriate relays for Transformer 1 and 12kV Bus 1. Additionally, the relaying scheme was checked to insure proper operation.